

Automated Phone and Mail Population Outreach to Promote Colorectal Cancer Screening

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Objectives: To evaluate a population outreach program to promote screening for colorectal cancer (CRC) among average-risk insured men and women.

Study Design: In 2008, 58,440 Kaiser Permanente Colorado members unscreened for CRC received an interactive voice response (IVR) call followed by mailed fecal immunochemical test (FIT), or colonoscopy if requested. We used a quasi-experimental design with staged implementation, in which a random subset of eligible members was selected each week to receive the intervention. This design allowed the entire group to ultimately receive the intervention.

Methods: Survival models summarized time-specific comparisons of screening behaviors for members who received immediate outreach compared with those who had not yet received it.

Results: A total of 26,003 (45%) of the unscreened population completed screening, predominately due to the mailed kits. The unadjusted hazard ratio (HR) for the outreach effect on screening completion was 4.08 (95% confidence interval: 3.93-4.25) and adjusted HR was 3.75 (3.60-3.91). Lower levels of screening were seen in African Americans (HR 0.83; 0.77-0.90) and Hispanics (HR 0.84; 0.80-0.88) compared with whites, and in smokers (HR 0.77; 0.74-0.80) compared with nonsmokers. The outreach had greater impact among those without a primary care (HR 4.5 vs 3.0, $P < .0001$) or specialty care (HR 5.2 vs 3.5, $P < .0001$) visit compared with those with 1 or more visits.

Conclusions: The rate of colorectal cancer screening in members after mailed FIT with IVR was almost 4 times higher than usual care, particularly in those without an office visit. Targeted approaches are needed for groups at risk for not screening.

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Mortality from colorectal cancer (CRC) is declining, yet it remains the second-leading cause of cancer death in the United States and the leading cause among nonsmokers. Screening of average-risk men and women aged 50 to 75 years is recommended by the US Preventive Services Task Force (USPSTF) as well as specialty organizations because early detection of high-risk adenomas and cancers is associated with decreased CRC incidence and mortality.¹⁻⁷ Screening with fecal occult blood testing and sigmoidoscopy have been shown in clinical trials to decrease CRC mortality.⁶⁻⁸ Evidence of effectiveness for screening colonoscopy remains indirect,⁹ though 1 recent case-control study did show a significant benefit.¹⁰ Screening rates for CRC lag behind rates for breast and cervical cancer and vary by socioeconomic status, insured status, and ethnicity.^{7,11}

The age-adjusted prevalence for screening (fecal occult blood test [FOBT] within a year or lower endoscopy within 10 years) in 2010 was 65.4% for adults aged 50 to 75 years, up from 52.3% in 2002.¹² The ability to screen large numbers of individuals for CRC in a cost-effective manner is critical as states and large health plans assume more responsibility for aging populations. The fecal immunochemical test (FIT) offers increased sensitivity for cancer and specificity compared with standard guaiac FOBTs. Thus FIT is a non-invasive low-cost option which may achieve higher levels of population acceptance than primary colonoscopy.^{3,13-19} The ability to process large numbers of samples by machine facilitates mass screening. This paper describes our quasi-experimental evaluation of a large outreach program using an interactive voice response (IVR) call followed by mailed FIT, or colonoscopy if requested, to increase screening among average-risk men and women in a non-profit integrated care delivery system.

METHODS

Study Setting and Data Sources

Kaiser Permanente Colorado (KPCO) is a not-for-profit integrated care delivery system with over 530,000 members. KPCO uses an electronic medical record (EMR) and multiple population registries for prevention and chronic disease management programs. The CRC registry includes family history,

In this article
Take-Away Points / p371
www.ajmc.com
Full text and PDF



diagnoses, procedures, and pathology dating back to 1994. For this study, the registry was used to determine eligibility in April 2008 for CRC screening in members who had continuous enrollment until April 2009, the end of the study period. The study protocol was approved by the Institutional Review Board and Research Review Committees of KPCO. The need for individual signed consent was waived.

Take-Away Points

We used a quasi-experimental design to evaluate a large outreach program in an insured population to promote colorectal cancer screening by stool testing or colonoscopy.

- Unscreened members received an educational automated call and mailed immunochemical stool test.
- Forty-five percent of unscreened members completed screening within the study period.
- The outreach had even greater impact among members without a primary care visit (HR 4.5 vs 3.0, $P < .0001$) or specialty care visit (HR 5.2 vs 3.5, $P < .0001$) compared with those with 1 or more visits.
- Targeted approaches are additionally needed for groups at risk for not screening.

Outreach Protocol

In fall 2007, KPCO replaced the 3 sample guaiac FOBTs with the 1 sample FIT from Polymedco (Cortland Manor, New York). From April through mid-September 2008, a systematic outreach program targeted all unscreened average-risk men and women at a rate of 3000 IVR calls a week (Figure 1). The call lasted approximately 5 minutes and included options for education about screening modalities. Members could clarify risk status and, if eligible, request a mailed FIT kit as well as rank their perception of barriers to screening. The registry was updated with new information regarding high-risk status, and the member's provider was notified for colonoscopy referral if requested. Average-risk members who completed the call and requested stool testing were mailed a kit within 2 weeks. Kits included an invitational letter with information about stool testing, an FIT kit with instructions, and a prepaid return envelope. A section in Spanish gave a phone number to call for assistance in Spanish. Members who did not complete the IVR call were mailed the FIT kit 30 days later. If the kit was not returned, a reminder letter was sent at 4 weeks. Members with negative FIT results were notified by mail; positive results were sent electronically through the medical record to the primary care provider for referral. Members with positive studies who did not complete diagnostic evaluation received a reminder letter at 8 weeks followed by a certified letter at 16 weeks. The program sent yearly FIT tests on the anniversary date of initial testing for members who chose to screen by FIT and remained eligible.

Both the IVR and outreach letter also offered colonoscopy as a screening option. Members were informed that not all cancers are found by stool testing and that colonoscopy would be required if their FIT test was positive. Members who chose colonoscopy for screening were asked to contact their provider for a referral and the outreach program notified the provider through the EMR.

Usual Care

Efforts to increase screening began before 2008 and included provider and staff education, new promotional materials for members, panel screening reports, and quality incentive

programs. The CRC registry prompted in-reach alerts printed on individual check-in sheets in primary care visits for all age- and risk-eligible members, stating "colorectal screening may be due" and providing a phone number for members to report prior screening or risk status. This in-reach alert continued until there was documentation of screening refusal, a completed FIT, or colonoscopy pathology.

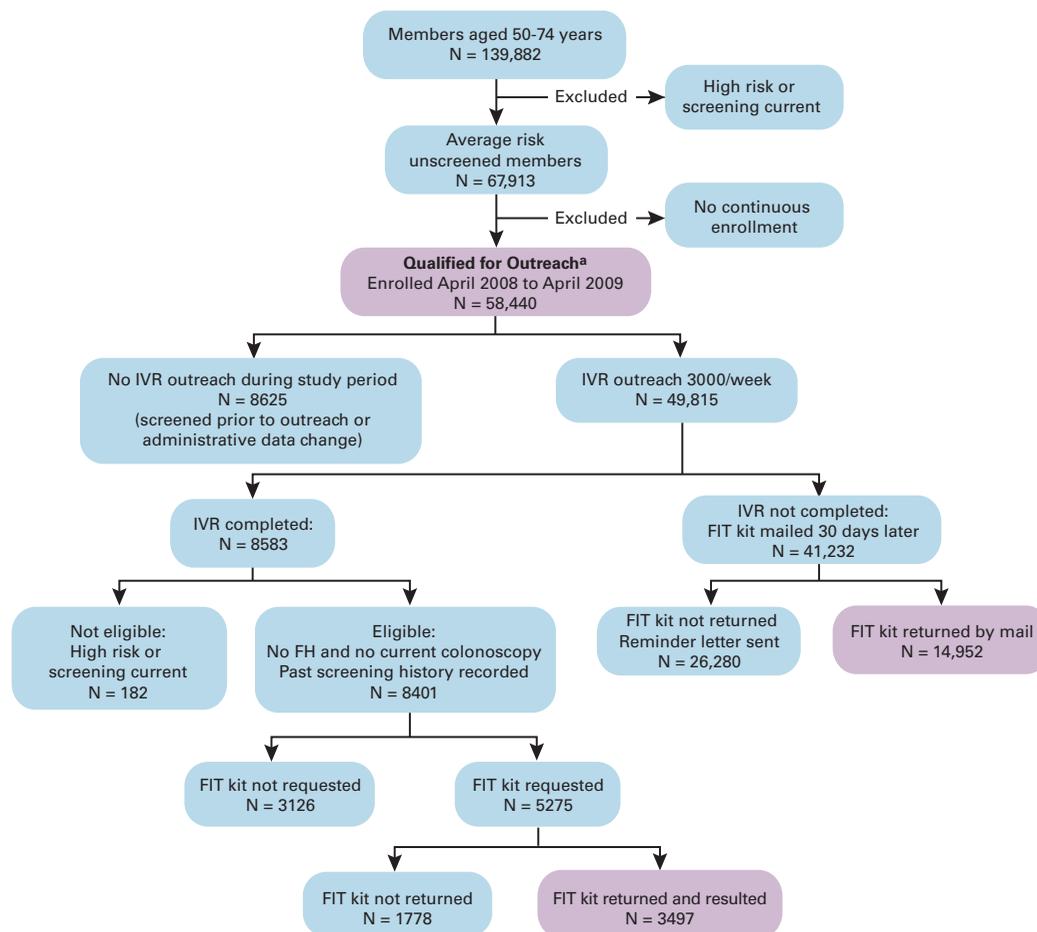
Participant Selection for Outreach

A summary of study exclusions and the flow of the outreach for FIT testing is shown in Figure 1. Initial exclusions included high-risk status, removal from the registry by personal physician due to comorbidities, or evidence of completed screening. High-risk status included personal history of CRC or polyps, family history (first-degree relative) of CRC, inflammatory bowel disease, and genetic syndromes. Average-risk members were assumed to be unscreened if they did not have a completed FOBT or FIT within 12 months or a colonoscopy within 10 years. Members who had had barium enema or flexible sigmoidoscopy within 5 years were eligible for FIT outreach, as the combination of FIT with either was judged to improve screening effectiveness.² The CRC registry tracked members according to their risk status and most recent screening modality. All average-risk members who were unscreened in April 2008 and were continuously enrolled until April 2009 were used for the analysis reported here (N = 58,440).

Study Design and Statistical Analysis

We used a quasi-experimental design with staged implementation, in which a random subset of eligible members was selected each week to receive the intervention. This design allowed the entire group to ultimately receive the intervention, while not exceeding the capacity of providers and systems during any single time period. The timing of outreach was randomized by medical record number. Survival models summarized time-specific comparisons of screening behaviors for members, comparing exposed and unexposed person-time, with each individual contributing a variable amount to the immediate

■ **Figure 1.** FIT Outreach Protocol Summary



FH indicates family history (first-degree relative); FIT, fecal immunochemical test; IVR, interactive voice response.
^aScreening colonoscopy (N = 5255) could also be requested at any point in the outreach.

and to the delayed intervention control groups. This analytic strategy isolated the effect of the outreach from the effects of usual care received by all members during the study period. While all members received the outreach between April and September 2008, the follow-up period extended an additional 6 months until April 2009. All members eligible at the start of outreach were included and analyzed by intention to treat.

The analysis was done in 2010 and used SAS 9.13 (SAS Institute, Cary, North Carolina). The primary outcome was a 2-category variable: screened by FIT or colonoscopy versus remaining unscreened April 2008 through April 2009. Analysis variables included age, gender, race/ethnicity, smoking status, body mass index (BMI), enrollment in a chronic disease registry, and visit history within the past year. Cox proportional hazards models estimated the time to screening completion using the time of the IVR call, which initiated the outreach, as a time-varying covariate.²⁰ In addition to main effects, interaction terms examined whether the outreach effectiveness varied across race/ethnic sub-

groups and by evidence of having had a visit in primary care, obstetrics/gynecology (Ob/Gyn), or specialty care during the past year.

We also conducted secondary univariate analyses to compare characteristics of those choosing FIT versus colonoscopy during the study period. To evaluate sustainability, a descriptive analysis identified members who completed FIT screening after the initial outreach, were still enrolled and eligible on their year 2 anniversary date, and completed a second FIT.

RESULTS

Participant Characteristics

The characteristics of the entire study population are shown in **Table 1**; this table does not compare intervention and control groups because, by design, all members ultimately received the intervention after a variable time delay. The study group of 58,440 included 8625 members who did not receive IVR/FIT mailing due to previously un-



Population Outreach for Colorectal Cancer Screening

Table 1. Characteristics in Screened Versus Unscreened Members by End of Study Period (April 2008 to April 2009)

Characteristic ^a	Study Group (N = 58,440)	Unscreened (N = 32,437)	Screened by FIT or Colonoscopy (N = 26,003)	P
Age				<.001
Mean ± SD	58.8 ± 6.3	58.2 ± 6.0	59.5 ± 6.6	.06
Median (min-max)	57.7(50.0-74.0)	57.1 (50.0-74.0)	58.7 (50.0-74.0)	
Age categories				<.001
50-64	47,324	27,404 (57.9%)	19,920 (42.1%)	
65-74	11,116	5033 (45.3%)	6083 (54.7%)	
Gender				.082
Female	30,980	17,092 (55.2%)	13,889 (44.8%)	
Male	27,460	15,346 (55.9%)	12,114 (44.1%)	
Race/ethnicity^b				<.001
White	32,912	15,052 (48.5%)	16,960 (51.5%)	
African American	1402	779 (55.6%)	623 (44.4%)	
Hispanic	4634	2544 (54.9%)	2090 (45.1%)	
Other	1366	640 (46.9%)	726 (53.1%)	
Missing data	18,126	12,522 (69.1%)	5604 (30.9%)	
Smoking history^b				<.001
Nonsmoker	26,794	13,589 (50.7%)	13,205 (49.3%)	
Former smoker	15,461	7444 (48.1%)	8017 (51.9%)	
Smoker	8450	5140 (60.8%)	3310 (39.2%)	
Missing data	7735	6264 (81.0%)	1471 (19.0%)	
BMI^b				<.001
<25	13,505	6708 (49.7%)	6797 (50.3%)	
25-29	18,376	9312 (50.7%)	9064 (49.3%)	
30+	18,268	9747 (53.4%)	8521 (46.6%)	
Missing BMI	8291	6670 (80.4%)	1621 (19.6%)	

(Continued)

known screening or administrative data changes. A total of 26,003 (45%) completed screening: 3497 screened with FIT by request through the IVR call; 14,952 through mail-only FIT; 5255 screened by colonoscopy without prior FIT; and 1299 screened by FIT via usual care. The mean age was 58.8 years and 53% were female. Members aged 65 to 74 years were more likely to complete screening than members aged 50 to 64 years ($P < .001$). There were significantly lower rates of screening ($P < .001$) for African Americans, Hispanics, active smokers, members with increased BMI, and those missing demographic data. Members classified as having a chronic condition in KPCO disease registries had higher rates of screening than members not in disease registries. Screening completion was higher with a history of at least 1 visit in primary care, Ob/Gyn, or specialty departments. While 83% of members had at least 1 visit during the first year, 43% of members without any primary care visit during the year completed screening.

Analysis Results

Cox proportional hazards models were used to evaluate the impact of the outreach program on screening with either FIT or colonoscopy (Table 2, Figure 2). The unadjusted hazard ratio indicated a 4-fold (HR 4.09; 95% CI: 3.93-4.25) increase in screening compared with the delayed intervention control group; the effect was reduced after adjustment for selected patient factors (HR 3.75; 3.60-3.91). Having missing demographic data in any category, reflecting less engagement with care delivery, was associated with decreased response to outreach. Significant interactions ($P < .0001$) were found between the outreach effect and visit history (Table 3). The impact of the outreach was greater for members with no visit in primary care (HR 4.47; 4.24-4.72) compared with members with 1 or more visits (HR 3.0; 2.86-3.20). For members with specialty care visits, the impact of the outreach was even higher, with an HR of 5.16 (4.69-5.68) with no visit and 3.54 (3.39-3.70) with 1 or



■ **Table 1.** Characteristics in Screened Versus Unscreened Members by End of Study Period (April 2008 to April 2009) (Continued)

Characteristic ^a	Study Group (N = 58,440)	Unscreened (N = 32,437)	Screened by FIT or Colonoscopy (N = 26,003)	P
Disease registry				
Asthma				<.001
No	54,177	30,286 (55.9%)	23,891 (44.1%)	
Yes	4263	2151 (50.5%)	2112 (49.5%)	
Chronic kidney disease				<.001
No	57,553	32,026 (55.6%)	25,527 (44.4%)	
Yes	887	411 (46.3%)	476 (53.7%)	
Coronary heart disease				<.001
No	55,491	30,997 (55.9%)	24,494 (44.1%)	
Yes	2949	1440 (48.8%)	1509 (51.2%)	
Diabetes				<.001
No	52,930	29,576 (55.9%)	23,354 (44.1%)	
Yes	5510	2861 (51.9%)	2649 (48.1%)	
Heart failure				<.001
No	57,697	32,066 (55.6%)	25,631 (44.4%)	
Yes	743	371 (49.9%)	372 (50.1%)	
Hypertension				<.001
No	33,026	19,912 (60.3%)	13,114 (39.7%)	
Yes	25,414	12,525 (49.3%)	12,889 (50.7%)	
Visit history^c				
Any visit				<.001
0	9895	7767 (78.5%)	2128 (21.5%)	
1+	48,545	24,670 (50.8%)	23,875 (49.2%)	
Primary care visit				<.001
0	37,611	21,361 (56.8%)	16,250 (43.2%)	
1+	20,829	11,076 (53.2%)	9753 (46.8%)	
Female Ob/Gyn visit				<.001
0	25,645	14,754 (57.5%)	10,891 (42.5%)	
1+	5335	2337 (43.8%)	2998 (56.2%)	
Specialty care visit				<.001
0	16,285	11,793 (72.4%)	4492 (27.6%)	
1+	42,155	20,644 (49.0%)	21,511 (51.0%)	

BMI indicates body mass index; FIT, fecal immunochemical stool test; Ob/Gyn, obstetrics/gynecology; SD, standard deviation.

^a χ^2 For all categorical variables, *t* test for continuous variable (age).

^bRemoving "missing data" from these categories did not change the *P* value or relative percentiles for associations of screening status with ethnicity, smoking status, or BMI.

^cWithin 1 year of initiation of intervention.

more visits. There was no significant interaction by race/ethnicity ($P >.4$ for African Americans and Hispanics) on the effect of the outreach.

Program Results

The IVR calls were completed by 17% of outreached members. The 182 members who self-identified in the IVR as already screened or high risk were not mailed an FIT kit. Nearly 80% of those who completed CRC screening through the outreach

chose FIT and there were no significant differences in screening modality choice by gender or ethnicity. Although FIT was the predominant choice of both younger and older members, younger members chose colonoscopy more often than older members (23% compared with 16%). Members screened by colonoscopy were also more likely to have done so if they had had any office visit. By the end of the study period, 79% of those with positive FIT results had undergone colonoscopy; the remainder continued to receive active outreach up to and



including certified letters. In the second year of the program, 9435 (47.8%) of the original 19,748 who chose FIT in year 1 and were still eligible completed it again.

DISCUSSION

We found that a population-based outreach intervention, consisting of an initial IVR call followed by mailed FIT, resulted in an almost 4-fold increase in the rate of screening completion for CRC in those who had just received the outreach compared with those who had not yet received it and were exposed to usual care. The outreach extended access to screening to all eligible members and was particularly effective in those without an office visit. This program was modeled on the organized mailed FIT outreach in another Kaiser region²¹ but added an educational IVR call and the option to request screening colonoscopy through the IVR or the mailed kit; further, our study design allowed us to quantify the impact of the outreach compared with usual care and external societal influences. In population screening programs to promote colorectal cancer screening, test effectiveness and adherence must be aligned with other factors for scalability, sustainability, and reach. The KPCO program incorporates many of the effective approaches recommended by the National Institutes of Health in its consensus statement on improving colorectal cancer screening, including reduction in structural barriers, individual risk stratification, education, choice in screening modalities, and infrastructure to track results and referrals.^{22,23}

Table 2. Predictors of Screening Completion by FIT or Colonoscopy by End of Study Period

	Adjusted Hazard Ratio (95% CI) ^a
Outreach intervention^b	3.75 (3.60-3.91)
Age categories	
50-64 y	0.78 (0.76-0.80)
65-74 y (reference)	
Gender	
Female	0.88 (0.86-0.91)
Male (reference)	
Race/ethnicity	
African American	0.83 (0.77-0.90)
Hispanic	0.84 (0.80-0.88)
Other	1.06 (0.99-1.14)
Missing	0.84 (0.81-0.86)
White (reference)	
Smoking history	
Smoker	0.77 (0.74-0.80)
Former smoker	1.01 (0.98-1.04)
Missing	0.92 (0.85-0.99)
Nonsmoker (reference)	
BMI category	
25-29 (overweight)	0.94 (0.91-0.97)
30+ (obese)	0.86 (0.83-0.89)
Missing	0.75 (0.69-0.80)
<25 (reference)	
Disease registry inclusion	
Asthma	
Yes	0.94 (0.90-0.98)
No (reference)	
Chronic kidney disease	
Yes	1.01 (0.92-1.11)
No (reference)	
Coronary heart disease	
Yes	0.94 (0.89-0.99)
No (reference)	
Diabetes	
Yes	0.88 (0.85-0.92)
No (reference)	
Heart failure	
Yes	0.91 (0.81-1.00)
No (reference)	
Hypertension	
Yes	1.05 (1.02-1.08)
No (reference)	
Visit history in 1 year	
Primary care visit	
1+	1.28 (1.25-1.32)
0 (reference)	
Ob/Gyn visit for female	
1+	1.32 (1.27-1.38)
0 (reference)	
Specialty care visit	
1+	1.90 (1.84-1.96)
0 (reference)	

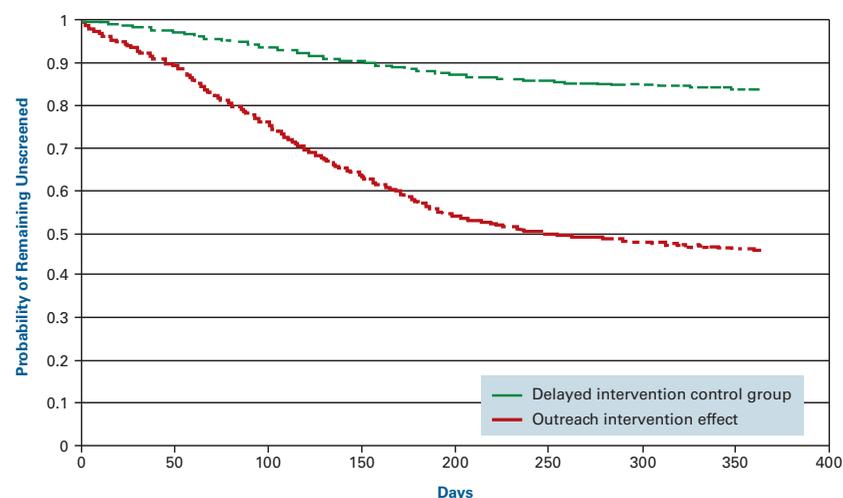
BMI indicates body mass index; CI, confidence interval; FIT, fecal immunochemical test; IVR, interactive voice response; Ob/Gyn, obstetrics/gynecology.

^aEach hazard ratio is adjusted for all other variables in table.

^bOutreach intervention initiated by IVR call. At the time of screening, likelihood of screening completion was compared between those exposed to outreach and delayed intervention control group.



■ **Figure 2.** Screening Completion in Those Exposed to Outreach Compared With Delayed Intervention Control Group



The transition from a 3-sample FOBT to the 1-sample automated version of the FIT made this population outreach possible. The FIT test supports home screening and offers the convenience of no change in diet or medications and no bowel prep; 1 sample testing has been shown to improve compliance.^{4,24-26} An analysis of the automated 1-sample FIT (OC Sensa Micro, Eiken Chemical, Tokyo, Japan) showed that at the FDA-recommended level of 100 ng/ml used here, sensitivity for advanced adenomas was 23.7% (specificity 94.0%) and sensitivity for cancer 69.2% (specificity 93.7%).²⁷ While the optimal cutoff for test positivity may be lower, improved sensitivity must be balanced against downstream operational and clinical impacts in large programs.²⁸ The USPSTF estimates that the effectiveness of annual FIT screening equals that of every- 10-year colonoscopy, assuming perfect adherence with either test.²⁹ Cost-effectiveness analysis shows that, if adherence can be maintained, a program based on annual FIT can

be cost saving and comparable to colonoscopy every 10 years.³⁰ Increased use of FIT screening drives downstream demand for colonoscopy and necessitates increased endoscopy capacity. The cumulative increases in the number of colonoscopies performed in KPCO members have been accompanied by a gradual attenuation in completed screenings by annual stool testing (Figure 3). Thus, FIT provides a low-cost, convenient, non-invasive option for members and appears to function best as a component of a multi-modal screening program.

This screening program included an initial IVR call to educate members about CRC screening and to gather personal information on current screening status and CRC risk factors. Seventeen percent of unscreened members completed the call, which may reflect low activation in the target population. Our completion rate for other prevention outreach calls such as mammography reminders averages 20 percent. However, our chronic disease programs or clinical trials which use IVR to facilitate a prearranged care plan and provide direct links to pharmacy or clinical staff have had rates of call completion of over 40 percent. Despite the low response rate to IVR in our outreach, the call intervention provided useful information on risk status and identified those who were up-to-date with screening, averting the unnecessary or inappropriate mailing of a FIT kit. Other interventions to promote CRC screening using IVR to educate or address readiness without making screening easier to accomplish have failed,^{31,32} whereas calls which facilitated completion of a mailed test or colonoscopy have improved screening rates.³³⁻³⁵ Both IVR and direct mail

strategies have the potential to facilitate care independent of the office setting. In this program, the dominant modality driving the outcome in our population was the direct mailing of the FIT test to members who ignored the IVR call.

A systematic approach to CRC screening is necessary but not sufficient to fully address barriers for low screening groups even in an insured population. At KPCO, where all eligible members received a mailed kit and the option to request colo-

■ **Table 3.** Impact of Office Visit Within 1 Year on Outreach Effect Hazard Ratios^a

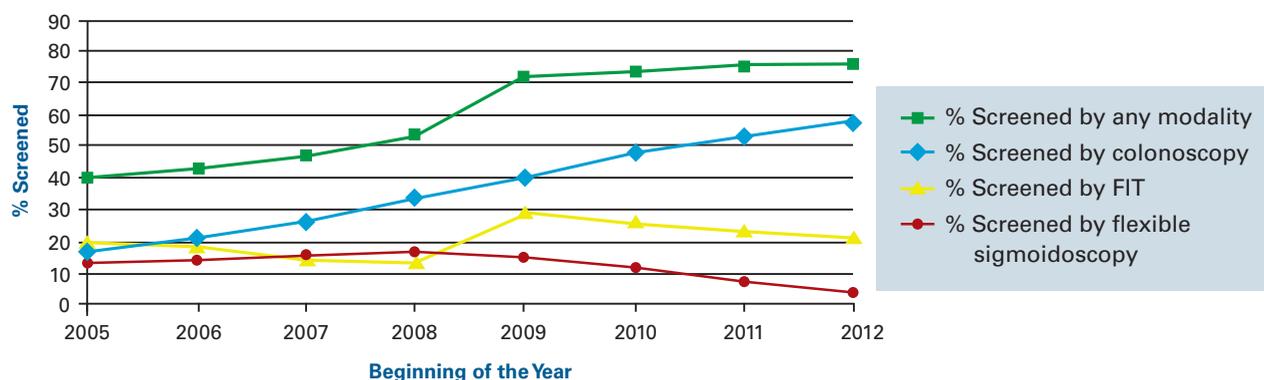
	Outreach Effect HR (95% CI)	P value of Interaction (Visit History by Outreach)
Primary care visit		<i>P</i> < .0001
1+	3.02 (2.86-3.20)	
0	4.47 (4.24-4.72)	
Ob/Gyn visit for female		<i>P</i> < .002
1+	3.17 (2.88-3.50)	
0	3.84 (3.68-4.01)	
Specialty care visit		<i>P</i> < .0001
1+	3.54 (3.39-3.70)	
0	5.16 (4.69-5.68)	

^aAdjusted for age, gender, race/ethnicity, smoking history, BMI category, and comorbidity factors. BMI indicates body mass index; CI, confidence interval; HR, hazard ratio; Ob/Gyn, obstetrics/gynecology.



Population Outreach for Colorectal Cancer Screening

■ **Figure 3. KPCO CRC Screening Rates Over Time**



CRC indicates colorectal cancer; FIT, fecal immunochemical test; KPCO, Kaiser Permanente Colorado.

noscopy, 44% of previously unscreened African Americans and 45% of unscreened Hispanics completed screening, compared with 52% of previously unscreened white members. Studies which have evaluated screening preferences for minority groups show that, while multiple factors influence these choices, colonoscopy and FOBT are among the preferred options and providing a choice of modality may also increase adherence.³⁶⁻³⁹ Because tailored messages have been shown to encourage CRC screening completion,⁴⁰ current KPCO strategies are focused on tailoring of the mail and IVR arms of the program for African American and Hispanic members. Members who smoke or have an elevated BMI, both of which are associated with increased risk of CRC,⁴ also had lower response rates, but interventions are difficult to implement for these groups at a population level.

Strengths of this study include the setting of an integrated delivery system, the use of a population registry for CRC screening, the random assignment of the timing of outreach, access to race/ethnicity and disease registries, and visit history data. Although there were concurrent initiatives to support CRC screening as well as efforts to increase public awareness at both the state and national levels, the analysis controlled for these factors by comparing the intervention group with a delayed intervention, temporally matched control group. From 2006 to 2008, CRC screening rates among the insured population in Colorado as a whole improved only 3 points, from 62% to 65%.⁴¹ The CRC screening rates for KPCO members in 2006, 2007, and 2008 were 47%, 53%, and 72%, respectively, an absolute increase of 25 percentage points, correlating with the initiation of the population outreach program. At the end of 2011, 4 years after implementation, 76% of KPCO members 50 to 75 years of age had been screened, with 27% having completed FIT and 76% having completed colonoscopy. The CRC population outreach intervention has been sustained and

remains a cornerstone of CRC screening management, valued by clinicians as supportive of their population health efforts.

A study limitation is that this analysis relied on cohorts recreated from dynamic operational databases, and minor discrepancies in membership could have occurred. The recreated cohort appears accurate given that a review of saved, static IVR call records matched the recreated cohort for 98% of members called in April 2008. Because 53% of our members were already screened before the outreach, those studied here who were unscreened despite exposure to usual care may differ in important ways from those who were already screened. However, this analysis demonstrates the effectiveness of a multi-modal population outreach to promote colorectal screening and confirms the need for additional tailored interventions for vulnerable groups.

CONCLUSIONS

The rate of screening for CRC by stool testing or colonoscopy in members after a large population outreach by mailed FIT with IVR was almost 4 times higher than usual care, particularly in those without an office visit. Targeted approaches are needed for groups at risk for not screening.

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script for important intellectual content (KLK, SMS, EKF, TRL); statistical analysis (SMS, EKF); provision of study materials or patients (KLK, TRL); obtaining funding (KLK, EKF); administrative, technical, or logistic support (KLK, EKF); and supervision (EKF).

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REFERENCES

- 1. US Preventive Services Task Force.** Screening for colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2008;149(9):627-637.
- 2. Whitlock EP, Lin JS, Liles E, Bell TL, Fu R.** Screening for colorectal cancer: a targeted, updated systematic review for the U. S. Preventive Services Task Force. *Ann Intern Med.* 2008;149(9):638-658.
- 3. Rex DK, Johnson DA, Anderson JC, Schoenfeld PS, Burke CA, Inadomi JM; American College of Gastroenterology.** American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol.* 2009;104(3):739-750.
- 4. Levin B, Lieberman DA, McFarland B, et al; American Cancer Society Colorectal Cancer Advisory Group; US Multi-Society Task Force; American College of Radiology Colon Cancer Committee.** Screening and surveillance for early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the U.S. Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. *Gastroenterol.* 2008;134(5):1570-1595.
- 5. Lieberman D.** Progress and challenges in colorectal cancer screening and surveillance. *Gastroenterol.* 2010;138(6):2115-2126.
- 6. Winawer SJ, Zauber AG, Ho MN, et al.** Prevention of colorectal cancer by colonoscopic polypectomy: the National Polyp Study Workgroup. *N Engl J Med.* 1993;329(27):1977-1981.
- 7. Atkin WS, Edwards R, Kralj-Hans I, et al; UK Flexible Sigmoidoscopy Trial Investigators.** Once-only flexible sigmoidoscopy screening in prevention of colorectal cancer: a multicenter randomized controlled trial. *Lancet.* 2010;375(9726):1624-1633.
- 8. Hewitson P, Glasziou PP, Irwig L, Towler B, Watson E.** Cochrane systematic review of colorectal cancer screening using the fecal occult blood test (hemocult): an update. *Am J Gastroenterol.* 2008;103(6):1541-1549.
- 9. Neugeit AI, Leibold B.** Colonoscopy vs sigmoidoscopy screening: getting it right. *JAMA.* 2010;304(4):461-462.
- 10. Brenner H, Chang-Claude J, Seiler CM, Richert A, Hoffmeister M.** Protection from colorectal cancer after colonoscopy. *Ann Intern Med.* 2011;154(1):22-30.
- 11. Shavers VL, Jackson MC, Sheppard VB.** Racial/ethnic patterns of uptake of colorectal screening, National Health Interview Survey 2000-2008. *J Natl Med Assoc.* 2010;102(7):621-635.
- 12. Vital signs: colorectal cancer screening, incidence, and mortality—United States, 2002-2010.** *MMWR Morb Mortal Wkly Rep.* 2011;60(26):884-889. Centers for Disease Control and Prevention website. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6026a4.htm?s_cid=mm6026a4_w.
- 13. Hundt S, Haug U, Brenner H.** Comparative evaluation of immunochemical fecal occult blood tests for colorectal adenoma detection. *Ann Intern Med.* 2009;150(3):162-169.
- 14. Haug U, Hundt S, Brenner H.** Quantitative immunochemical fecal occult blood testing for colorectal adenoma detection: evaluation in the target population of screening and comparison with qualitative tests. *Am J Gastroenterol.* 2010;105(3):682-690.
- 15. Allison JE.** FIT: a valuable but underutilized screening test for colorectal cancer—it's time for a change. *Am J Gastroenterol.* 2010;105(9):2026-2028.
- 16. Allison JE, Sakoda LC, Levin TR, et al.** Screening for colorectal neoplasms with new fecal occult blood tests: update on performance characteristics. *J Natl Cancer Inst.* 2007;99(19):1462-1470.
- 17. Young GP, Cole SR.** Which fecal occult blood test is best to screen for colorectal cancer [published online ahead of print January 27, 2009]? *Nat Clin Pract Gastroenterol Hepatol.* 2009;6(3):140-141.
- 18. Young GP, Cole SR.** New stool screening tests for colorectal cancer [published online ahead of print October 19, 2007]. *Digestion.* 2007;76(1):26-33.
- 19. Oono Y, Iriguchi Y, Doi Y, et al.** A retrospective study of immunochemical fecal occult blood testing for colorectal cancer detection [published online ahead of print February 23, 2010]. *Clin Chim Acta.* 2010;411(11-12):802-805.
- 20. Allison PD.** Estimating Cox regression models with PROC PHREG. In: *Survival Analysis Using the SAS System: A Practical Guide.* Gary, NC: SAS Institute Inc; 1995.
- 21. Levin TR, Jamieson L, Burley DA, Reyes J, Oehrli M, Caldwell C.** Organized colorectal cancer screening in integrated health care systems. *Epidemiol Rev.* 2011;33(1):101-110.
- 22. Steinwachs D, Allen JD, Barlow WE, et al.** National Institutes of Health State-of-the-Science Conference Statement: enhancing the use and quality of colorectal cancer screening. *Ann Intern Med.* 2010;152(10):668-676.
- 23. Holden DJ, Jonas DE, Porterfield DS, Reuland D, Harris R.** Systematic review: enhancing the use and quality of colorectal cancer screening. *Ann Intern Med.* 2010;152(10):668-676.
- 24. Hoffman RM, Steel S, Yee EFT, Massie L, Schrader RM, Murata GH.** Colorectal cancer screening adherence is higher with fecal immunochemical tests than guaiac-based fecal occult blood tests: a randomized controlled trial. *Prev Med.* 2010;50(5-6):297-299.
- 25. Van Rossum LG, van Rijn AF, Laheij RJ, et al.** Random comparison of guaiac and immunochemical fecal occult blood tests for colorectal cancer in a screening population. *Gastroenterol.* 2008;135(1):82-90.
- 26. Hol L, van Leerdam ME, Ballegooijen M, et al.** Screening for colorectal cancer: randomized trial comparing guaiac-based and immunochemical faecal occult blood testing and flexible sigmoidoscopy. *Gut.* 2010;59(1):62-68.
- 27. Park D, Ryu S, Kim YH, et al.** Comparison of guaiac-based and quantitative immunochemical fecal occult blood testing in a population at average risk undergoing colorectal cancer screening. *Am J Gastroenterol.* 2010;105(9):2017-2025.
- 28. Levin TR.** Optimizing colorectal cancer screening by getting FIT right. *Gastroenterol.* 2011;141(5):1551-1555.
- 29. Zauber AG, Lansdorp-Vogelaar I, Knudsen AB, Wilschut J, van Ballegooijen M, Kuntz KM.** Evaluating test strategies for colorectal cancer screening: a decision analysis for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2008;149(9):659-669.
- 30. Parekh M, Fendrick AM, Ladabaum U.** As tests evolve and costs of cancer care rise: reappraising stool-based screening for colonic neoplasia. *Aliment Pharmacol Ther.* 2008;27(8):697-712.
- 31. Simon SR, Zhang F, Soumerai SB, et al.** Failure of automated telephone outreach with speech recognition to improve colorectal cancer screening. *Arch Intern Med.* 2010;170(3):264-270.
- 32. Constanza ME, Luckmann R, Stoddard AM, et al.** Using tailored telephone counseling to accelerate the adoption of colorectal cancer screening [published online ahead of print July 23, 2007]. *Cancer Detect Prev.* 2007;31(3):191-198.
- 33. Mosen DM, Feldstein AC, Perrin N, et al.** Automated telephone calls improved completion of fecal occult blood testing. *Med Care.* 2010;48(7):604-610.
- 34. Denberg TD, Myers BA, Lin CT, Levine J.** Screening colonoscopy through telephone outreach without antecedent provider visits: a pilot study. *Prev Med.* 2009(48):91-93.
- 35. Daly JM, Levy BT, Merchant ML, Wilbur J.** Mailed fecal-immunochemical test for colon cancer screening. *J Community Health.* 2010;35(3):235-239.
- 36. Hawley ST, Volk RJ, Krishnamurthy P, Jibaja-Weiss M, Vernon SW, Kneuper S.** Preferences for colorectal cancer screening among racially/ethnically diverse primary care patients. *Med Care.* 2008;46(9):S10-S16.
- 37. Schenck AP, Klabunde CN, Davis WW.** Racial differences in colorectal cancer test use by Medicare consumers. *Am J Prev Med.* 2006;30(4):320-326.
- 38. Shokar NK, Carlson CA, Weller SC.** Prevalence of colorectal cancer testing and screening in a multiethnic primary care population. *J Community Health.* 2007;32(5):311-323.
- 39. Harden E, Moore A, Melvin C.** Exploring perceptions of colorectal cancer and fecal immunochemical testing among African Americans in a North Carolina community. *Prev Chronic Dis.* 2011;8(6):A134. http://www.cdc.gov/pcd/issues/2011/nov/10_0234.htm.
- 40. Walsh JM, Salazar R, Nguyen TT, et al.** Healthy colon, healthy life: a novel colorectal cancer screening intervention. *Am J Prev Med.* 2010;39(1):1-14.
- 41. Colorado Department of Public Health and Environment (CDPHE). Behavioral Risk Factor Surveillance System Survey Data.** Denver, Colorado: Center for Health and Environmental Information and Statistics, Health Statistics Section, 2006, 2008. ■

